

## **Title of the project**

The Last Bloom

## **Team members**

Qi Yu

Yuzhu Xiong

## **Vision statement & summary of the project idea**

In 2077, the environment has been seriously threatened due to pollution and ecological destruction, and a war between humans and aliens has caused severe biological extinction. All plants on the earth have been extinct except one cyborg plant. You are assigned a special mission to transfer the last survival plant to the laboratory, which contains the only piece of uncontaminated soil on earth. After completing the mission you will be awarded a special medal by Alliance for Human Development.

Time is urgent, please start immediately...

## **The goal of the project**

Our project allows players to learn the severity of pollution is having a devastating impact on plant growth and diversity. The unique experience within our project can help our users develop or increase empathy towards wildlife and understand that they have the ability to help reduce pollution. We hope this experience ultimately transforms our users to become more pro-environment in real life.

We choose the first-person perspective in our game, the player is able to look through the character's eyes and see the world from their perspective. By looking through the character's eyes, the player gets a sense that they are actually inside the world of the game, and it is easier for the player to interact with the world of the game. Additionally, the character becomes a blank slate for the player, the player can project themselves onto the game. It feels less like they are controlling a game character than they are the character.

## **Visual style of the project**

The visual style of our project is semi-realistic. We want our environment to be visually stunning but at the same time make it realistic enough for the participant to relate to the real world.

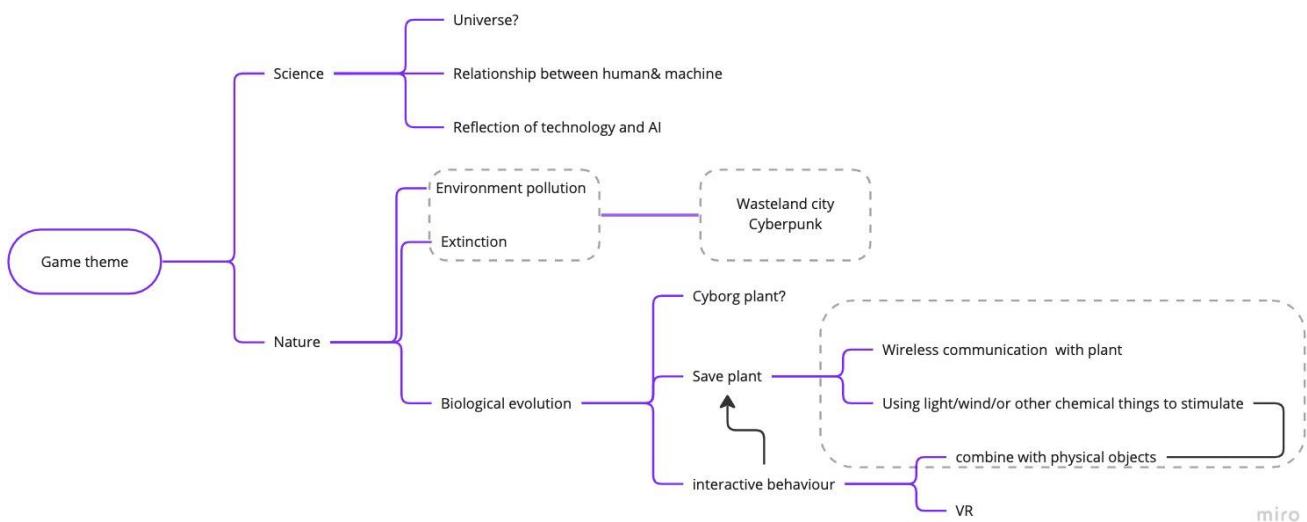
### **Cyborg plant**

<https://www.pinterest.com/pin/851954454516890980/>  
<https://www.pinterest.com/pin/140737557095264101/>  
<https://www.pinterest.com/pin/64528207153347066/>  
<https://www.pinterest.com/pin/851954454515684504/>

## Cyborg city

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## Project Inspiration



<https://miro.com/app/board/uXjVPopHPOs=/#tpicker-content>

## Relevant Research

### **Social networking in crop plants: Wired and wireless cross-plant communications**

<https://onlinelibrary.wiley.com/doi/full/10.1111/pce.13966>

Signals can also be transferred between plants via different mechanisms, which we classify as wired- and wireless communications. Wired communications involve direct signal transfers between plants mediated by mycorrhizal hyphae and parasitic plant stems. Wireless communications involve plant volatile emissions and root exudates elicited by microbes/insects, which enable inter-plant signalling without physical contact.

### **Plant Sensing and Communication**

<https://www.degruyter.com/document/doi/10.7208/9780226264844/html?lang=en>

Plants sense many aspects of their abiotic and biotic environments and respond with a variety of plastic morphologies and behaviours that are often adaptive. In addition, plants communicate, signalling to

remote organs within an individual, eavesdropping on neighbouring individuals, and exchanging information with other organisms ranging from other plants to microbes to animals.

They do this using a variety of receptors and feedback mechanisms, including phytochrome receptors to detect light, mechanical sensing to detect gravity, and chemical feedback to detect CO<sub>2</sub>. The stimuli that plants sense include both abiotic factors and those caused by other plants, microbes, and animals.

## Narrative/Story

In the year 2077, Earth is on the brink of environmental collapse and devastated by a war between humans and aliens. The once-thriving ecosystems have been decimated, and all plant life has become extinct, except for a single cyborg plant, which holds the key to restoring the planet's biodiversity.

You, the player, assume the role of a skilled operative assigned by the Alliance for Human Development. Your mission is to safeguard and transport the last surviving plant to a top-secret laboratory containing the only remaining uncontaminated soil on Earth.

As you embark on this urgent quest, you find yourself navigating through a desolate and hostile virtual world. The landscapes are barren, ravaged by pollution, and teeming with alien remnants. Your character must overcome various challenges and obstacles along the way to find the cyborg plant.

To interact with the environment and progress through the game, you use a game controller to control your avatar's movements. Additionally, you have access to an ultrasonic sensor that allows you to trigger specific animations in the game world. The carbon dioxide sensor acts as a means of communication with the plant, providing hints and insights crucial to your mission's success.

As you journey towards the laboratory, you unravel the backstory of the war, the causes of the environmental devastation, and the significance of the cyborg plant. You also encounter non-playable characters who provide essential information and assistance, leading to unexpected plot twists and revelations.

The game culminates in a climactic finale as you reach the laboratory, where the fate of the last surviving plant and the future of Earth rests in your hands. Your actions and decisions throughout the game determine the ultimate outcome, whether it be a successful restoration or a tragic failure.

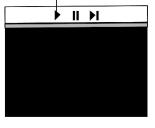
# Storyboard

phase/scene	pre-game	Transition into game	Game experience	Exit from game
Real world	The team introduces the experience to the user.	The player enters the booth.	The player uses XXX to navigate and interact with the game environment and start on the assigned task.	The player steps away from the computer and gets the exclusive achievement from the game.
Game environment	The environment would be loaded into the computer.	The environment awaits the player to enter.	The player enters the game environment and completes the experience.	Asking the players how they feel about the experience.
Non-visual perception	Nothing particular	The user gets a brief introduction to the task.	The player exits the set-up.	Nothing particular
Cognition	By introducing the experience to the player, we will establish a connection between them and the character.	"Wondering how the experience will be."	We want the player to think about and get used to the basic controls of the game as well as what interactable objects look like.	We want the player to reflect on the game experience.

## Game Mechanics

### How to Interact

**STEP 1**



Click  
Click this button to let the game set up!

**STEP 2**



Close to the ultrasonic!  
It will let you be able start playing maybe waving your hand in front of it!

**STEP 3**



Press this button to start!

**STEP 4**



Moving!  
Control movement  
Control perspective  
Try to catch the energy capsule! Don't be burned by the fire!

Blowing heavily!  
You need to using your blowing air as the signal, let the last bloom know you  
The last bloom will give some introduction of your moving direction!  
Keep blowing!

### Your Assignment

**Save the plant!**

- This is the last plant on the earth
- Plant can use biotic signal to communicate, outside stimulation(wind, temperature) can also change the signal

**Take the plant and transmit it to the laboratory!**

Get the capsule Stop acid rain Get the plant Go to the lab

When you see the achievement metal, the game is over.

**Attention**

Energy capsule is for healing The fire can burn you.

## Core mechanics

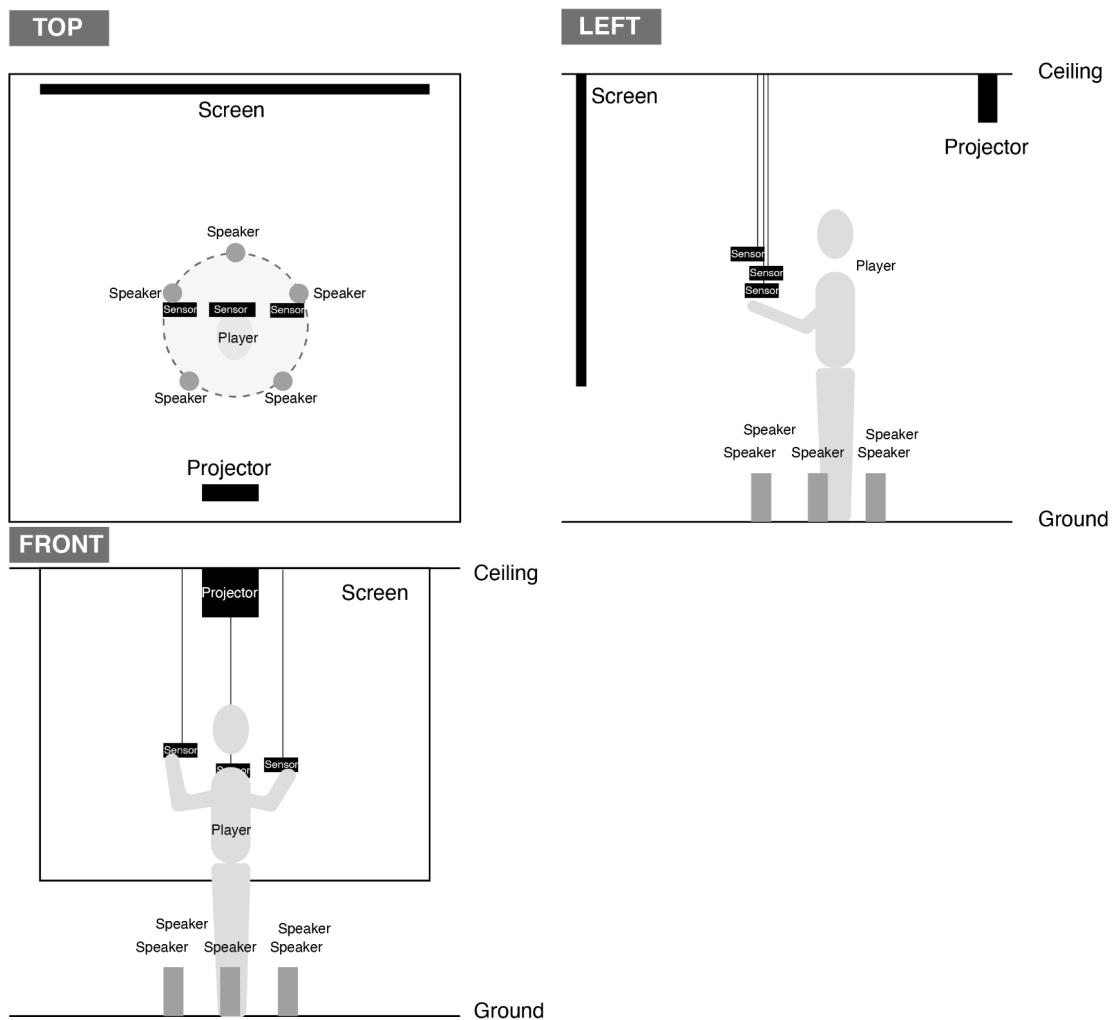
Our core mechanics is to allow players to walk around in the virtual world, players would be using the game controller to move and control the actions of the avatar. Players utilise an ultrasonic sensor and an MQ135 CO2 sensor to interact with various elements. The primary objective is to locate the plant, transport it to the lab, and collect energy capsules to recover the player's energy while avoiding flames caused by dry weather. Players can use the ultrasonic sensor as a tool to trigger animation and blow into the carbon dioxide sensor to elicit responses from the plant, gaining hints or information vital to find the plant and bring it to the laboratory.

## Secondary mechanics

**The number of players:** 1

**Target audience:** 18 - 40, people who are interested in learning about the effect of pollution on plants.

**Physical setup:**



# Why our project is innovative

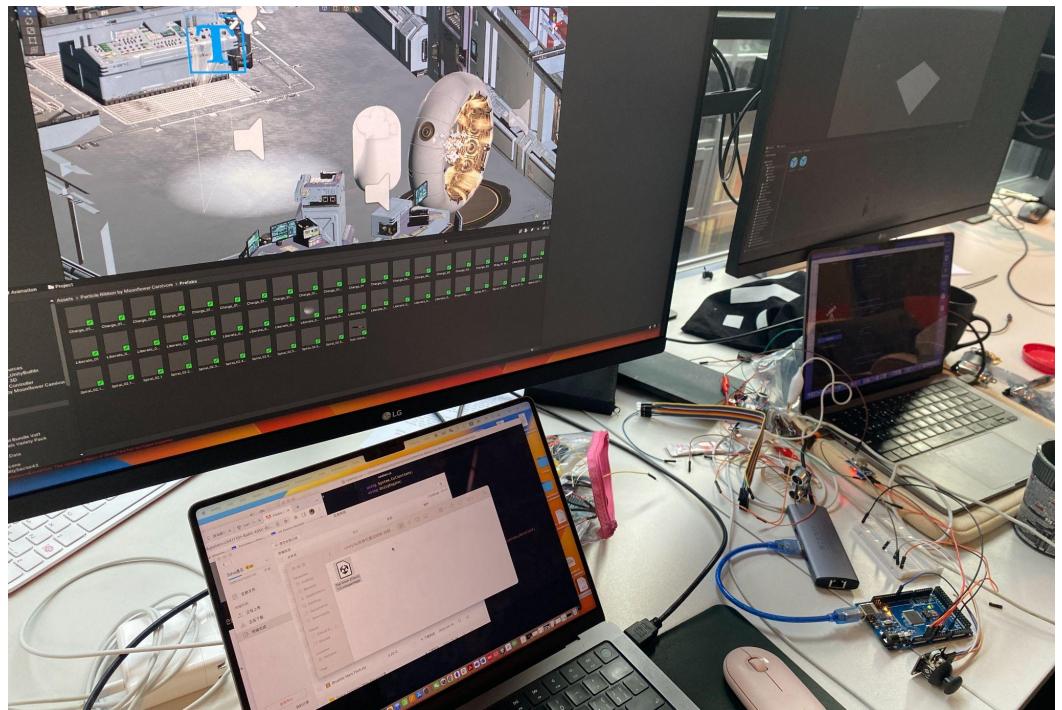
## Main “selling point”

The integration of Arduino sensors allows players to interact with the game world in a more tangible and immersive way. The ultrasonic sensor enables players to trigger specific animations and events by using real-world gestures or movements. This enhances the sense of presence and makes the gameplay experience more engaging and interactive. The use of the carbon dioxide sensor adds a physical element to the gameplay. By blowing into the sensor, players can communicate with the cyborg plant and receive hints or information crucial to their mission. This physical interaction creates a unique and immersive experience that bridges the gap between the virtual and physical worlds. Players can also learn about the importance of carbon dioxide levels for plant life and gain a better understanding of environmental issues. This combination of gameplay and education fosters a more informed and environmentally conscious player base.

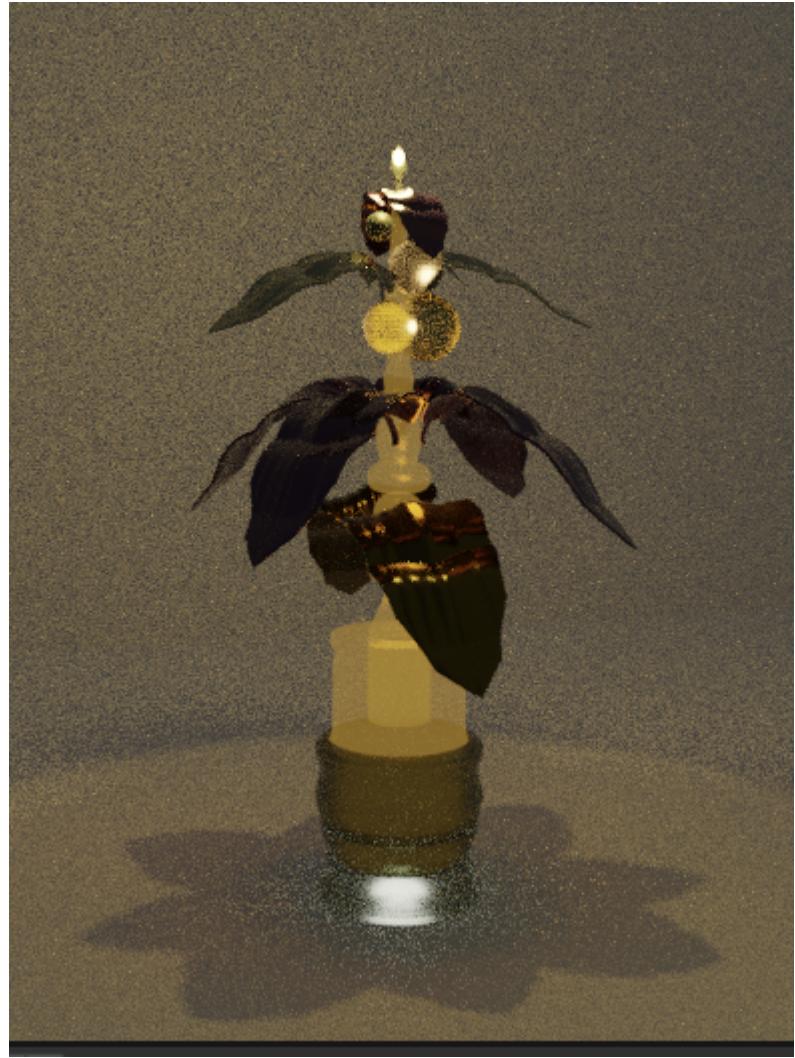
## Prototyping process

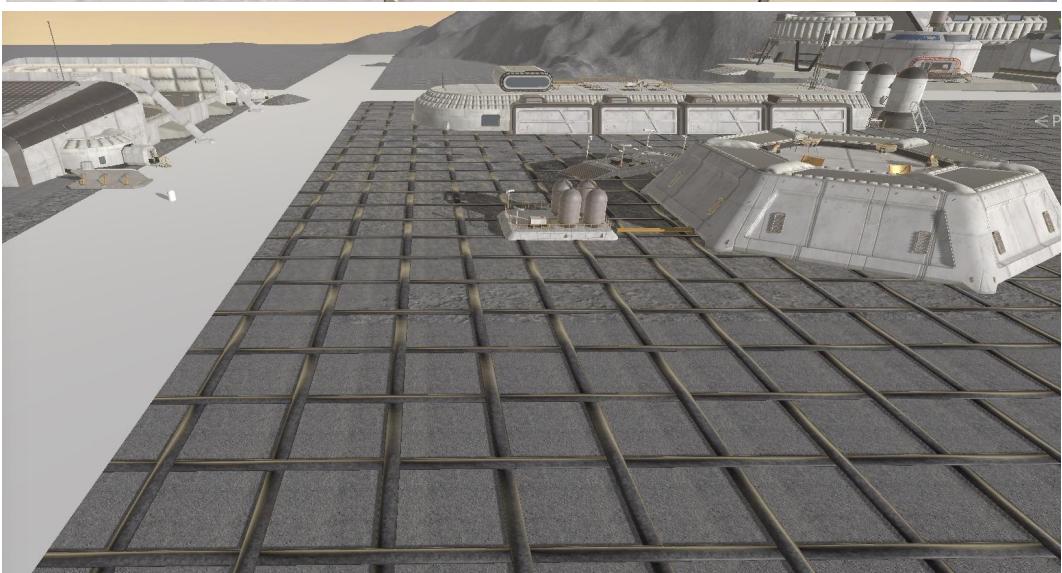
Initial sketches (cyborg plant)	
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**Arduino progress  
(testing with  
Arduino joystick)**



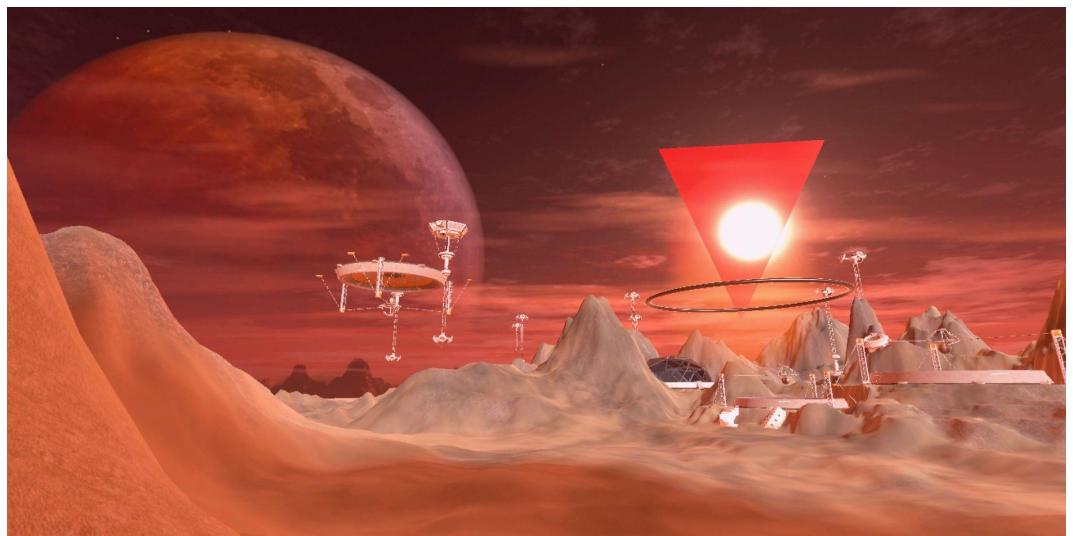
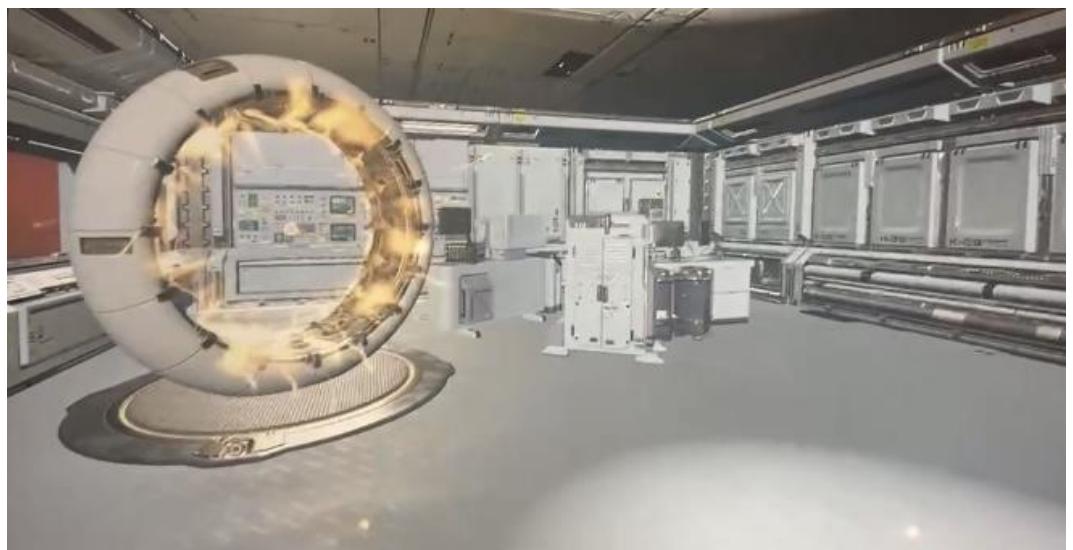
**first version  
(models and scene)**



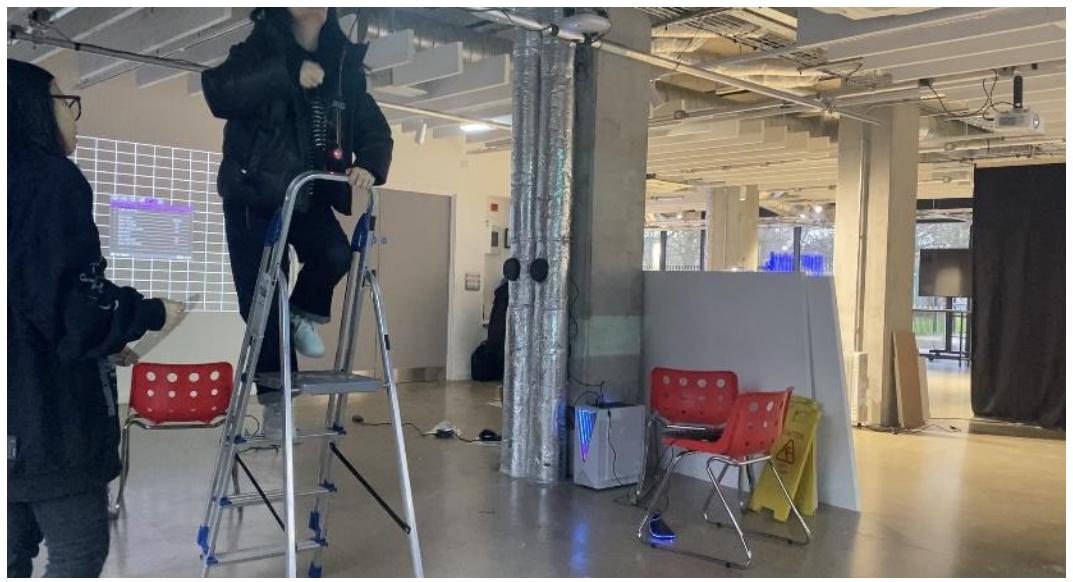


**second version  
(model and scene)**





**Exhibition setup**



## Final outcome





## Problems encountered and solutions

During the project's development, several problems were encountered, particularly related to the integration of Arduino sensors. Here are some of the challenges faced and potential solutions:

Initially, we planned to connect an Arduino joystick with Unity to allow players to move within the game scene. However, it was discovered that the movement with the joystick was not smooth, which impacted the overall gameplay experience. Then we have to change our gameplay mechanics and switch to using the game controller for player movement, which offers more precise and responsive inputs, leading to smoother movement within the game scene.

The game's development presented challenges such as lag caused by too many models in Unity and the limited memory capacity of Unity. If a vast amount of data from Arduino is quickly sent to Unity, message loss may occur after a certain number of messages. Additionally, the MQ135 sensor necessitated frequent recalibration due to the varying CO<sub>2</sub> levels in the game environment, which restricted the game's exhibition.

# Coding Reference

**Arduino Tutorial Series: Connecting to Unity(button)**

<https://medium.com/interface-lab/arduino-tutorial-series-connecting-to-unity-eedc48e77087>

**Measuring CO2 Concentration in Air using Arduino and MQ-135 Sensor**

<https://circuitdigest.com/microcontroller-projects/interfacing-mq135-gas-sensor-with-arduino-to-measure-co2-levels-in-ppm>

**MQ135 Arduino**

<https://microcontrollerslab.com/interfacing-mq-135-gas-sensor-arduino/>

**DUAL AXIS JOYSTICK MODULE + Unity3d , integrate hardware with unity3d**

<https://www.youtube.com/watch?v=uAMnOz1I9Xc&list=PLazvcyckcBwjJte649VApod0HY0fpnbzA&index=4>

**How to integrate Arduino with Unity - hardware work with software**

<https://www.youtube.com/watch?v=SD3iUnLNjY0>

**Unity Gravity**

<https://docs.unity3d.com/ScriptReference/Physics-gravity.html>

**Big dome push button**

<https://www.instructables.com/Big-dome-push-button-LinkIt-basics-PART-1/>

<https://www.youtube.com/watch?v=BC7YEGL2R20>

**Ultrasonic**

<https://projecthub.arduino.cc/Iaac100/7cabe1ec-70a7-4bf8-a239-325b49b53cd4>

**SoundPlayer**

<https://www.youtube.com/watch?v=ln4ilSVR1Ug>

**AudioClip.length**

<https://docs.unity3d.com/ScriptReference/ AudioClip-length.html>

<https://answers.unity.com/questions/963843/audiosource-play-certain-time-range-1.html>

**Audio Compress**

<https://www.acglobby.com/unity-audio%E8%B5%84%E6%BA%90%E4%BC%98%E5%8C%96/>

**Unity3D VideoPlayer**

<https://www.cnblogs.com/0kk470/p/10637034.html>